Entry, Expansion, and Intensity in the U.S. Export Boom, 1987-1992

Andrew B. Bernard*
Tuck School of Business, Dartmouth College
National Bureau of Economic Research

J. Bradford Jensen
Center for Economic Studies, Bureau of the Census
University of Maryland

August 2001

Abstract

U.S. exports grew at a rate of 10.3% per year from 1987-1992, far faster than the economy as a whole and faster than in any other five year period since 1960. This paper examines the sources of the export boom considering the role of entry, firm expansion and export intensity. The preponderance of the increase in exports came from increasing export intensity at existing exporters rather than from new entry into exporting. The small role of entry relative to export intensity offers support for the importance of sunk costs in the export market. In addition, we consider competing explanations for the rise in exports using a comprehensive plant level data set. Changes in exchange rates and rises in foreign income were the dominant sources for the export increase, while productivity increases in U.S. plants played a relatively small role.

KEY WORDS: sunk costs, export intensity, exchange rates
JEL Classification: F10, F14

*100 Tuck Hall, Hanover, NH 03755, tel: (603) 646-0302, fax: (603) 646-0995, email: andrew.b.bernard@dartmouth.edu

An early version of this paper circulated under the title "Understanding the U.S. Export Boom". The data used in this paper are confidential but not exclusive. The research in this paper was conducted at the Center for Economic Studies. Research results and conclusions expressed are those of the authors and do not necessarily indicate concurrence by the Bureau of the Census or the National Bureau of Economic Research. The paper has not undergone the review the Census Bureau gives its official publications. It has been screened to insure that no confidential data are revealed.

1. Introduction

U.S. exports boomed in the late 1980s and early 1990s. No matter how one slices the data, the results are the same. After seven years of stagnation, the value of total U.S. exports took off after 1987, increasing at an average annual rate of 10.3% through 1992.[1] Growth rates for exports of goods and especially those of durable goods were even higher. Figure 1 shows five year average growth rates for real GDP and real exports since 1962.[2] Export growth rates during 1987-92 were substantially higher than the 6.5% annual average since 1960. By contrast, annual growth in real GDP averaged only 2.4% over the same period, less than its 40 year average of 3.3%. This resurgence in exports led to a huge sigh of relief from observers of U.S. manufacturing. Largely gone were the worries and woes of the 1980s that the U.S. had lost its edge. Instead, optimism abounded about the competitiveness of the manufacturing sector.

In this paper, we question whether such a buoyant feeling was justified from the export numbers alone and investigate the sources and nature of the export boom. Using data from individual plants for the entire manufacturing sector, we consider the relative importance of improvements in U.S. productivity, the depreciating dollar, and rising foreign incomes in fostering the boom. In attempting to understand the nature of the boom, we place it in its recent historical context and look at the roles of new exporters and continuing exporters. We consider all the possible margins of adjustment including entry, plant growth, and increasing export intensity. In particular, we consider the role of sunk costs to entering the export market in shaping the nature of the export boom.

There are as many explanations for the rebirth of the export sector as there are new exporters, however, two competing stories dominate the debate. The first hypothesis about the export boom focuses on the role of foreign factors, especially exchange rates. Proponents argue that the dollar depreciation of the mid 1980s actually drove the export increase albeit with a lengthy delay. The delay in response to the large exchange

[1] Economic Report of the President (2001). All values are given in $1996.

[2] The five year intervals were chosen to match the availability of the plant-level data.

rate movements is attributed to the presence of sunk costs of entry into exporting.

The second, and not necessarily mutually exclusive, hypothesis attributes the increase in exports to a general renewal of U.S. manufacturing, and in particular to increase in productivity at manufacturing establishments. The argument is that manufacturers undertook large restructuring efforts during the mid and late 1980s which improved productivity and thus enabled them to compete in world markets. We consider this hypothesis in terms of shifts of the cost curve for individual producers and ask whether such movements are strongly correlated with increased exports.

In conjunction with these two main hypotheses we also examine the role of sunk costs in determining the nature of the export boom. The theoretical debate over the slow response of U.S. exports to the decline in the dollar during the mid-1980s has focused on the existence of entry or sunk costs for potential exporters. As argued by Dixit (1989), Baldwin and Krugman (1989) and Krugman(1989), and shown formally by Meltiz (2001), if firms face one-time costs upon beginning to export, there will be a range of inaction in the face of seemingly favorable exchange rate shocks. Bernard and Jensen (2001) use plant-level data to test for the existence of such entry costs in the U.S. and find strong evidence in favor of sunk costs of exporting. A plant that is not exporting today is 40% less likely to be in the export market next year than a comparable plant that is an exporter today. Those results also show a positive but small increase in the probability that a firm will export when faced with favorable exchange rate movements. As a result of the presence of sunk costs, we would expect that the export-exchange rate elasticity for all firms taken together would be substantially smaller than that of today's exporters.

To evaluate these hypotheses, we first examine the contributions of new plants and new exporters to the export increases. While there has been an important increase in the numbers of plants exporting, by far the biggest increase in exports has come from existing exporters. We decompose the aggregate increase into two components, one due to increasing export intensity by individual exporters, and the other due to increasing shipments at relatively export intensive plants. Both effects are occurring during the boom but the increase in export intensity is the dominant effect.

As a more formal test, we regress changes in exports and export in-

tensity at the plant level on newly constructed industry export weighted exchange rates and industry level measures of foreign demand, as well as on plant productivity. The results suggest that all three variables are playing a role in the export increase but that the productivity effect is relatively small. The depreciation of the dollar coupled with increases in foreign income account for almost 90% of the export increase in the aggregate. In addition, the response of current exporters is substantially larger than that for other plants, suggesting that the combination of sunk costs and economy-wide events were the determining factors in shaping the export boom.

The paper proceeds as follows: the next section details the scope of the export boom across industries and regions. Section 3 put the recent increases in exports in a longer historical context. The contributions of new plants and new exporters are discussed in Section 4 as well as the role of increasing export intensity at the plant level. Section 5 contains the tests of the competing hypotheses using plant level data for all plants and continuing exporters. Section 6 presents the relative contributions of exchange rates, foreign income and plant productivity to aggregate export increases. Section 7 concludes.

2. Depth and Breadth of the Boom

Two facts suggest that the resurgence in U.S. exports may have been driven largely by external economy-wide factors. First, the increase in exports occurred in every manufacturing sector and in almost every state. The widespread nature of the export increase was remarkable. Every sector saw its exports rise by at least 50% from the 1987 level, while nine industries more than doubled their exports. There was more heterogeneity across states, although every one saw a rise in exports. At the plant level, more plants exported in 1992 than in 1987 and the exporters increased their share of shipments going abroad.

Second, the growth of the late 1980s merely returned U.S. exports to their long run trend levels. Export growth in the late 1990s, while still faster than overall output growth, returned to a stable 6.5% per year. Even though exports merely returned to long run trend levels during the boom, the export intensity of U.S. output increased at an unprecedented rate, both

for the manufacturing sector as a whole and for individual plants and firms. It is this increase of export intensity which represents the real export boom of the late 1980s and 1990s. Both these facts suggest that economy-wide factors rather than firm-specific success were the driving forces behind the boom. In this and the next sections we document these attributes of the export expansion.

The recent period of export growth truly was the rising tide that lifted all boats.[3] Every two-digit manufacturing industry had faster export growth than output growth.[4] Every state showed growth in exports and only six had slower export growth than manufacturing growth.[5] In addition, the proportion of manufacturing plants and firms that exported rose substantially and exporters shipped a higher fraction of their output abroad.

The export boom was felt in every industry in the manufacturing sector. Table 1 reports average annual growth rates for shipments and direct exports for 1987 and 1992 for each two-digit manufacturing sector. All 20 manufacturing sectors had double digit annual growth rates in exports during the period and nine sectors more than doubled their exports in five years.[6] Export growth was substantially higher than shipments growth in every industry, even textiles, furniture, and apparel were able to more than double their value of exports. Perhaps not surprisingly, traditionally strong export sectors continued to dominate the aggregate numbers. The

[3] All our plant and firm level figures come from the Census Bureau's Census of Manufactures (CM) for 1987 and 1992. The CM surveys U.S. manufacturing establishments and collects information on production and non-production employment, production hours, salaries and wages, shipments, value-added, capital measures, ownership structure, and direct exports. The coverage of exports is less than 100%. For details on this issue see Bernard and Jensen (1995). Due to limitations with the 1992 CM, we exclude all plants with fewer than 20 employees. Inclusion of these plants will not substantially change any of our conclusions as these plants are less likely to be exporters and account for a small fraction of U.S. manufacturing output and exports.

[4] Two-digit manufacturing industries are food, tobacco, textiles, apparel, wood, furniture, paper, printing, chemicals, petroleum, rubber, leather, stone, primary metals, fabricated metals, machinery, electronics, transportation, instruments, and miscellaneous manufacturing.

[5] The six, Minnesota, Missouri, Vermont, West Virginia, Wyoming, and South Dakota, accounted for only 6% of direct exports in 1987.

[6] These industry numbers represent direct exports reported by establishments in the Censuses of Manufactures. Actual export volume is higher, as indirect exports are not included.

top five exporting industries, transportation, machinery, chemicals, electronics and instruments, accounted for 77% of total exports in 1987 and 72% in 1992 and two-thirds of the total increase. Transportation and machinery remained the top two manufacturing export sectors and increased their exports at more than twice the rate of the increase in shipments. The breadth of the export boom gives clues as to its sources. Every industry participated, including those that were expanding rapidly such as chemicals and electronics as well as declining industries such as leather and stone. This broad scope of the increase suggests that the sources of the boom are likely to be factors that affect all sectors.

The shift into exporting across industries can also be seen in columns 3 and 4 of Table 1 which reports the share of exporting plants by industry. Nationally the fraction of exporting plants rose from 21% to 31% in just 5 years. The most export-intensive industries judged by participation rates were instruments, tobacco, chemicals, electronic equipment, and machinery which all had more than 33% of plants involved in the direct export market in 1987. In 1992 participation rates in these sectors had risen to more than 43%. However, striking changes also occurred in less likely areas. Primary metals saw an increase in exporting plants from 28% to 38% while the fraction of furniture exporters rose from 10% to 24%.

The export boom did not just touch all industries, it reached into almost every area of the country, as shown in Table 2. Except for the Northeast where every state had both sluggish or negative growth in shipments and only modest increases in exports, other regions showed substantial export growth. Traditional export states such as California, Ohio, and especially Washington all saw large rises in export volume. However, Idaho, Nebraska, and Georgia were among the fastest growing export states.

The export boom of the late 1980s and early 1990s swept across industries, regions, and plants. Participation rates in the international market soared in all sectors and a large fraction of the growth in manufacturing shipments can be associated with the increase in exports.

3. A Long Run Perspective

There is little question that the increase in exporting after 1987 was felt in every industry and every region of the country. However, the percep-

tion that the U.S. entered a new regime of increasing openness and export growth is due in large part to the contrast between the early 1980's and more recent years. For the five years from 1982 to 1987, the real value of U.S. exports grew at a rate of only 1.6% per year, while for the five years from 1987-1992, as noted earlier, export growth averaged 10.3% per year. However, in comparison to earlier periods, the export growth of recent years is less extraordinary.

Figure 2 shows the log-level of U.S. exports in billions of $1996 for the period 1959-1999. Export growth, represented by the change in the log-levels, averaged 6.5% for the entire period from 1959-1999. More remarkably, a log-linear trend fitted to value of exports from 1959-1973 predicts the level of exports in 1999 to within 0.1% of the actual value. There are four distinct phases in U.S. export performance over the 40 year period: sustained rapid growth from 1959-1981, low or negative growth rates until 1987, above average growth from 1987-1992, and average growth during the 1990s. It appears, at least from visual inspection of the data, that the increases in recent years have merely returned the level of exports to where it would have been in the absence of the dollar appreciation and world economic slowdown of the early 1980's.

If the export boom has not been an unusual event in terms of growth rates, the question remains why there is the widespread perception that the U.S. went through an unprecedented episode of increasing exports. The answer lies in the varying performance of the domestic economy over the same period. Figure 3 shows the export to GDP ratio for the U.S. from 1959-1999.

Again the picture reveals several distinct episodes. Both exports and GDP were growing rapidly during the 1960s and early 1970s, with exports increasing slightly faster, thus raising the export/GDP ratio from 0.032 in 1959 to 0.047 in 1972. Export growth rates rose somewhat in the rest of the 1970s while overall GDP growth rates slipped. By 1980 the export/GDP ratio had climbed to 0.071 where it stagnated during the export doldrums of the next seven years. The largest period of change for the export/GDP ratio was from 1987-1997 where it climbed to an unprecedented 12% of GDP.

This large increase in the share of GDP accounted by exports has been the single most important change during the so-called export boom. While

the level of exports is not unusually high, at least according to the standards of long run trend growth rates, the export/GDP ratio is at a post-WWII high. In the sections that follow we consider competing hypotheses about the source of the increase in exports and also the increase in export intensity.

4. Decomposing Export Growth

In attempting to understand the growth of exports in recent years, we start with a simple accounting exercise, decomposing the growth in aggregate exports into the contributions from existing plants, new plants, and new exporters. In doing this we hope to develop indirect evidence on the role of sunk costs of entering the export market. Melitz (2001) formalizes the role of sunk costs of entry to exporting in a model of heterogenous firms. In addition, a growing body of empirical work has documented the importance of sunk costs in decisions by individual firms to enter the export market.[7] High sunk costs of exporting would suggest that the export boom would be driven largely by increasing export intensity at existing exporters. These existing exporters have already sunk the cost of entry and are less constrained to respond to favorable exchange rate changes or increases in foreign demand.

Total direct exports reported by plants in the Census of Manufactures increased by $80.9bn from 1987 to 1992 (see Table 3). Of that total increase, 87% came from plants that existed in both years, while 13% came from the net change due to additions from new plants (29%) less the decline from plants that failed in the intervening years (-16%). For plants that existed in both years, exporters in both periods accounted for $49.7bn, or 61%, of the aggregate increase in exports. New exporters added $30.8bn in exports while there was a $9.7bn decline from plants exiting from the export market.

As noted earlier, the percentage of plants exporting increased from 21.5% to 31.2% in just five years (see Figure 4). While these new exporters played an important role in export growth over the period, contributing almost 40% of the total growth, the bulk of the increase came from increased export intensity at existing exporters. The scope of the increase in exports can be seen clearly in Figure 5 which shows the shift in the distribution of

[7] See Roberts and Tybout (1997), Bernard and Wagner (2001), and Bernard and Jensen (2001).

exporting establishments to the right. Among plants that export, greater numbers now export a larger fraction of their output, although the vast majority of exporters still ship a relatively small fraction of their output abroad. However, the export boom not only saw the numbers of exporters increase in every part of the distribution, but the increase was largest for plants that shipped a large portion of their output abroad.

Masked by these numbers is the extent to which individual plants increased their export intensity or merely increased their overall shipments, including exports. For any given plant, exports might increase because the plant became more export intensive or because shipments increased, even thought the exports/shipments ratio remained constant. We decompose the increase in aggregate exports into two components,

$$\Delta E = \underbrace{\sum_i \Delta S_i \overline{(E_i/S_i)}}_{\text{Growth Effect}} + \underbrace{\sum_i \Delta\left(E_i/S_i\right)\overline{S_i}}_{\text{Intensity Effect}} \tag{1}$$

for $i = 1, \ldots, I$ plants where ΔE is the aggregate change in exports, ΔS_i is the change in the level of shipments at plant i, $\Delta\left(E_i/S_i\right)$ is the change in the share of exports in shipments at plant i. $\overline{(E_i/S_i)}$ and $\overline{S_i}$ are time averages of (E_i/S_i) and S_i. The total increase in exports can stem from relatively large increases in shipments at export-intensive plants, the growth effect, or from increases in export intensity, the intensity effect, or some combination of the two.

Table 4 reports the two measures for new exporters (starters), former exporters (stoppers) and plants that export in both years. For all plants taken together as well as for exporters in both periods, increases in export intensity were the largest contributor to aggregate export growth. However, increased shipments at export-intensive plants accounted for more than 37% of the export increase in the aggregate and for more than 42% of the increase for continuing exporters. The decomposition confirms the earlier findings that the dominant characteristic of the export boom was an increase in export intensity, both at the plant level as well as for the economy as a whole. While not direct evidence on sunk costs, these decompositions offer additional evidence that entry in exporting is costly, even in the face of favorable aggregate shocks. In the next section we consider possible explanations for the increase in exports and export intensity.

5. Sources of the Boom

The two main competing (but not mutually exclusive) explanations for the resurgence in U.S. exports are the real devaluation of the dollar after 1985 and increased productivity at U.S. manufacturers. To these we add the rapid growth of incomes in U.S. trading partners during the period. In this section we test these hypotheses using the plant level data from the Censuses of Manufactures for 1987 and 1992. First, we discuss the differences between plants that export in the beginning of the period and those that are out of the export market initially. Next we present results for all plants taken together and exporters in both periods.

The theoretical debate over the slow response of U.S. exports to the decline in the dollar during the mid-1980s has focused on the existence of entry or sunk costs for potential exporters. Evidence for a variety of countries suggests there are substantial sunk costs to entering the exporter market.[8] As a result of the presence of sunk costs, we would expect that the export-exchange rate elasticity for all plants taken together would be substantially smaller than that of today's exporters.

plants already participating in the export market account for the bulk of the increase in exports. Starting from the assumption that individual exporters face downward sloping foreign demand for their products and that domestic supply shifts are uncorrelated with changes in demand, we can represent the quantity of exports from any individual plant as

$$E_{\mathsf{i}} = F(D, S) \tag{2}$$

where D is a vector of demand shifters including, but not limited to, increases in foreign income and movements in the exchange rate. S includes variables that shift the export supply, or cost, curve of the plant and can be represented by measures of plant level productivity. Normally, identification of supply and demand shocks is difficult and requires the use of appropriate instruments. In the case of exports at the plant level, however, the problem is substantially mitigated by the separation of factor markets, which are typically local, and demand which is generated abroad.

[8] See Roberts and Tybout (1997) for Columbia, Bernard and Wagner (2001) for Germany and Bernard and Jensen (2001) for the U.S.

Especially for an economy of the size of the U.S., it seems reasonable to assume that favorable changes in exchange rates and foreign income do not shift down the cost curves of individual domestic plants.[9] Similarly, foreign demand is very unlikely to be affected by domestic supply shocks.

A greater problem lies in the construction of suitable measures of changes in foreign demand. The use of aggregate exchange rate and foreign GDP measures is infeasible as they do not vary in interesting ways across plants, or even industries. Instead to capture changes in foreign demand, we construct industry specific (4 digit SIC) exchange rate and foreign income measures given as follows

$$XR_{\mathsf{j}} = \sum_{\mathsf{m}} \left(\frac{E_{\mathsf{jm}}}{E_{\mathsf{j}}} \right) \cdot XR_{\mathsf{m}} \tag{3}$$

$$Y_{\mathsf{j}} = \sum_{\mathsf{m}} \left(\frac{E_{\mathsf{jm}}}{E_{\mathsf{j}}} \right) \cdot Y_{\mathsf{m}} \tag{4}$$

where m indexes countries, E_{jm} is the value of exports from industry j to country m, E_{j} is the total value of exports from industry j, and XR_{m} and Y_{m} are the real exchange rate index and PPP-converted GDP of country m respectively. These industry variables are weighted exchange rate and income measures, where the weights represent the share of exports from the industry to the country.[10]

Our preferred measure of shifts in the supply curve is a measure of labor productivity at the establishment. We use valued-added per worker, VA/N, as the labor productivity measure and use plant level changes from 1987-1992 to represent shifts of the cost curve. A potential problem with such a variable arises if changes in export quantities or export intensity are sources of, rather than responses to, shifts in productivity. While we recognize this problem, recent work has found no positive feedback from exporting to productivity (see Clerides, Lach and Tybout 1998, and Bernard and Jensen 1999).

[9] In fact, if some fraction of intermediate inputs are imported then a depreciation will raise unit costs.

[10] We have industry export information for the top 25 US export destinations and use the average shares from 1984-1992 as the weights. The nominal country exchange rates are adjusted using GDP deflators and converted into indices where 1987=100. Foreign incomes are converted into constant dollars using 1990 PPP exchange rates.

To measure the growth in exports, we use two indicators. First we consider the percentage increase in exports as given by the log change in exports (Δ lnexports). However this measure is defined only for plants that export in both years, so we also use a measure of export growth at the plant given by

$$g_t = \frac{E_t - E_{t-1}}{0.5\,(E_t + E_{t-1})}.$$

This measure is defined for all plants whether or not they export in a given year and ranges from $[-2, 2]$.[11]

Finally, since the increase in export intensity at the plant level is the major contributor to the aggregate increase in exports, we also consider the determinants of the change in export intensity at the plant, given by the increase in the exports to shipments ratio,

$$\Delta \left(\frac{E_i}{S_i} \right).$$

We regress each of these measures of the increase from 1987 to 1992 in export activity at the plant on percentage changes in the exchange rate, productivity, and foreign income measures described above,

$$\Delta\text{Exports Measure}_{ij} = \beta_1 \Delta XR_j + \beta_2 \Delta \ln Y_j + \beta_3 \Delta \ln \left(\frac{VA}{N} \right)_{ij} + \epsilon_{ij}. \quad (5)$$

The expected coefficients are negative for β_1(a positive change in XR_j indicates an appreciation of the U.S. currency), positive for β_2, and positive for β_3.

Table 5 contains regression results for the change in exports and the exports-shipments ratio for all plants taken together over the period 1987-1992. By necessity, we include only plants for which we have observations

[11] Conventional measures of growth,

$$G_t = \frac{E_t - E_{t-1}}{E_{t-1}}$$

can be expressed as a function of this measure,

$$G_t = \frac{2g_t}{2 - g_t}.$$

in both years, eliminating all plants that fail during the interval and those that enter after 1987. The resulting sample accounts for 89% of exports in both years.

For the export growth measure, we find significant coefficients on all three variables with the expected sign in each case.[12] Both the exchange rate and foreign income quasi-elasticities are quite large, point estimates of -0.92 and 0.75 respectively, indicating that plants respond strongly to foreign demand shocks.[13] The export response to productivity improvements is significant and positive, but substantially smaller in magnitude with a point estimate of 0.033.

Using the change in export intensity as the dependent variable, we find again that the foreign variables have significant coefficients with the expected sign and of substantial magnitude. A 10% depreciation of the industry exchange rate is associated with an increase in export intensity of 0.4 percentage points at the average plant. Foreign income changes have even larger effects on the composition of output. A 10% rise in foreign income increases export intensity by 0.7 percentage points. Productivity improvements at the plant have no significant effects on the composition of output across foreign and domestic shipments, the sign of the coefficient is negative but not significant.

Since we would eventually like to be able to describe the aggregate export response to exchange rate movements, we rerun our specifications for the sample of plants that export in both 1987 and 1992. These continuing exporters account for over 70% of total exports in both years and the bulk of the increase in aggregate exports. Since this group of plants has already incurred any sunk costs in the decision to enter the foreign market, our estimates of the export responses should be greater than those for the sample of all plants taken together and should give us a "cleaner" estimate of the true export supply elasticities.

In Table 6, we report regression results for all three export measures and find, as expected, a much stronger supply response in this sample of plants. Both exchange rate and output supply elasticities are substantially

[12] For the panel of all plants, we do not report the regression for Δ lnexports since by construction it includes only plants that export in both periods. See Table 6.

[13] The use of this measure for export growth, i.e. $[E_t - E_{t-1}] / [0.5 (E_t + E_{t-1})]$, underestimates the true elasticities since it is bounded between -2 and 2 by construction.

greater than one. Even the productivity elasticity is more than four times larger for this group of plants, suggesting that sunk costs do indeed play a substantial role in determining the aggregate response to both supply and demand shocks.

For these exporting plants, the share of goods shipped abroad responds much more strongly to changes in exchange rates and foreign income. A 10% depreciation shifts 1.5% of output towards foreign sales while a 10% increase in foreign income raise export to sales ratios by 1.3%. However, productivity increases are now negatively related to export intensity suggesting the shifts of the supply curve increase domestic shipments faster than foreign shipments.

These results indicate that, to some degree, both changes in foreign demand, working through exchange rates and income, and changes in productivity played a role in the increase in exports from 1987 to 1992. However, to the extent that the export boom was associated primarily with increasing export intensity, the depreciation of the dollar and increases in foreign income were the most significant factors. To quantify the relative importance of the various factors, we calculate their contributions to aggregate export growth in the next section.

6. Contributions to Aggregate Export Growth

To assess the contributions of changes in exchange rates, foreign demand and domestic productivity to aggregate export growth, we assess the role of the three variables in export growth at each plant and then aggregate back up to determine the overall impact.

To start we make use of the decomposition reported in Equation 1,

$$\Delta E = \underbrace{\sum_i \Delta S_i \overline{(E_i/S_i)}}_{\text{Growth Effect}} + \underbrace{\sum_i \Delta\left(E_i/S_i\right)\overline{S_i}}_{\text{Intensity Effect}}.$$

The contribution of each plant to the aggregate increase in exports is given by the sum of the growth and intensity effects, i.e. the change in plant exports due to increased output with a constant export-shipments ratio and the change in plant exports due to increasing export intensity.

For the sample of all plants, we regress each of these components of plant export growth on our three explanatory variables and report the results in Table 7.

$$\Delta\text{Growth Effect}_{ij} = \delta_1 \Delta XR_j + \delta_2 \Delta \ln Y_j + \delta_3 \Delta \ln \left(\frac{VA}{N}\right)_{ij} + \epsilon_{ij}.$$

$$\Delta\text{Intensity Effect}_{ij} = \delta_4 \Delta XR_j + \delta_5 \Delta \ln Y_j + \delta_6 \Delta \ln \left(\frac{VA}{N}\right)_{ij} + \epsilon_{ij}.$$

For the intensity effect, all the variables have the expected signs and are significant, confirming the results from the previous regressions. Once again the magnitude of the foreign variables is substantially larger than for the productivity measure. Interestingly, for the growth effect regression, only the foreign demand and productivity changes are significant. The exchange measure is insignificant with the wrong sign.

To compute the contributions of the three variables to aggregate exports, we rerun the regressions for five quintiles of plants, ranked according to their employment size in 1987, and compute the contribution of the intensity and growth effects for each quintile to the aggregate increase in exports

$$\Delta E = \sum_q \sum_{i \in q} \left(\delta_1 \Delta XR_j + \delta_2 \Delta \ln Y_j + \delta_3 \Delta \ln \left(\frac{VA}{N}\right)_{ij} \right) \quad (6)$$

$$+ \sum_q \sum_{i \in q} \left(\delta_4 \Delta XR_j + \delta_5 \Delta \ln Y_j + \delta_6 \Delta \ln \left(\frac{VA}{N}\right)_{ij} \right) \quad (7)$$

The results are reported in Table 8, with the actual change in exports by quintile in the upper part of the table and the estimated exchange rate, foreign income and productivity contributions by quintile in the lower panel. As expected, the largest quintile of plants is by far the most important in terms of export quantities accounting for well over 80% of the total change in exports. Also, as reported earlier, the intensity effect accounts for almost two thirds of the aggregate export increase.

For the estimated changes, we can now assess the relative contribution of exchange rate, foreign income and productivity changes to the growth and intensity effects. The largest plants again dominate the aggregate

but looking across the size groups we find relatively little variation in the relative contribution of the three explanatory factors.

For the growth effect, the dominant component is foreign demand with productivity changes contributing about one quarter of the total. The exchange rate contribution is actually negative (remember the insignificant coefficient with the incorrect sign) but even adding the effects from the two foreign variables they still account for the bulk of the export increase.

The results for the intensity component are even stronger. The two foreign measures now make up over 97% of the total. In aggregate, changes in the exchange rates and especially foreign income account for over 90% of the change in exports. Productivity improvements do show up as significant but play a much more minor role in the overall export boom.

7. Conclusions

This paper contributes to the growing literature linking firms and international trade. We document the characteristics of the export boom of the late 1980s and early 1990s and place it in some historical context. We also attempt to discriminate between competing explanations for the boom. We consider two hypotheses, one which posits that the export boom was a response to favorable exchange rate and demand changes and another which argues that improved productivity in U.S. firms was the source of the increased exports.

We start by placing the export boom in a broader historical context. While export growth rates were substantially above average from 1987-92, the level and growth of real exports appears to have merely returned to long run trend levels. The growth rate of the late 1990s was almost exactly equal to the long run average. The truly unusual component of the export boom was the unprecedented increase in export intensity at all levels of the economy. Both individual firms and industries are shipping greater fractions of their goods abroad than at any previous time.

We use comprehensive plant-level data to investigate the source of both the rapid growth in exports and the increased intensity. Improvements in exchange rates (real depreciation) and foreign income are strongly associated with both increases in quantities of exports and especially increased export intensity. We find substantial indirect evidence of the existence

of sunk costs to exporting as existing exporters showed greater responses to favorable exchange rate and demand shocks. On the other hand, while productivity increases are indeed associated with increased exports at the plant level, they are not systematically related to increased export intensity. Finally we present an attempt to quantify the importance of the various factors and find that, in aggregate, productivity gains from 1987-1992 accounted for under 10% of overall export growth. Foreign income growth and exchange rate changes were the dominant sources of the export boom.

References

Baldwin, Robert. (1988) "Hysteresis in Import Prices: The Beachhead Effect." American Economic Review, 78(4) pp.773-785.

Baldwin, Robert and Paul Krugman. (1989) "Persistent Effects of Large Exchange Rate Shocks." Quarterly Journal of Economics, Vol. 104, No. 4 pp. 635-654.

Bernard, Andrew B. and J. Bradford Jensen. (1995). "Exporters, Jobs, and Wages in U.S. Manufacturing, 1976-1987." Brookings Papers on Economic Activity, Microeconomics. Washington DC.

Bernard, Andrew B. and J. Bradford Jensen. (1999). "Exceptional Exporter Performance: Cause, Effect, or Both?" Journal of International Economics, Vol. 47, pp. 1-25.

Bernard, Andrew B. and J. Bradford Jensen. (2001). "Why Some Firms Export". NBER Working Paper # 8349.

Bernard, Andrew B. and Joachim Wagner. (2001). "Export Entry and Exit by German Firms." Weltwirtschaftliches Archiv Vol. 137, No.1.

Clerides, Sofronis, Saul Lach and James Tybout. (1998) "Is "Learning-by-Exporting" Important?" Quarterly Journal of Economics, August, pp. 903-948.

Council of Economic Advisers. (2001). Economic Report of the President, January 2001. U.S. Government Printing Office, Washington, DC.

Dixit, Avinash. (1989) "Hysteresis, Import Penetration, and Exchange Rate Pass-Through." Quarterly Journal of Economics, Vol. 104, No. 2 pp. 205-228.

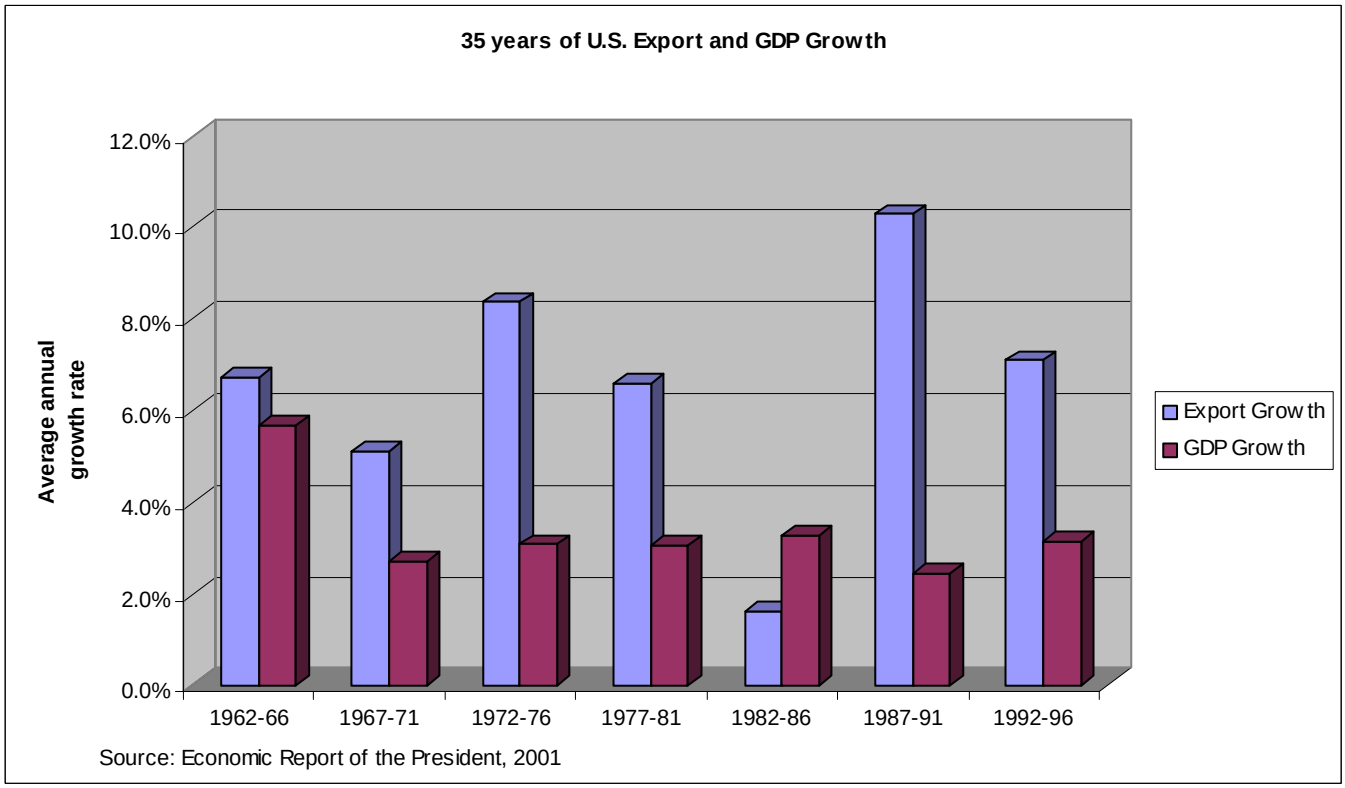
Krugman, Paul. (1989) Exchange Rate Instability. MIT Press, Cambridge MA.

Melitz, Marc (2001) "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity" Harvard University working paper.

Roberts, Mark and James Tybout. (1997). "The Decision to Export in Columbia: An Empirical Model of Entry with Sunk Costs." American Economic Review, 87(4), 545-564.

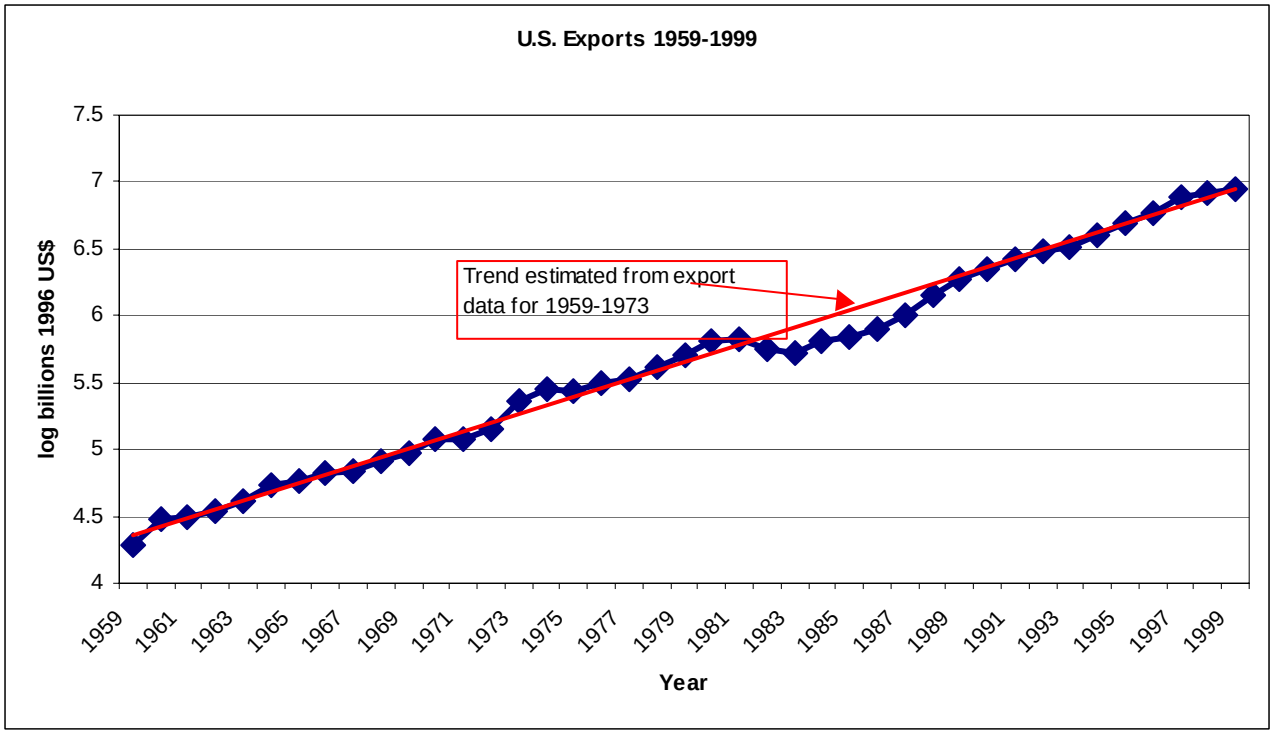
U.S. Bureau of the Census. (1987). Census of Manufactures General Summary MC87-S-1. Department of Commerce.

Figure 1



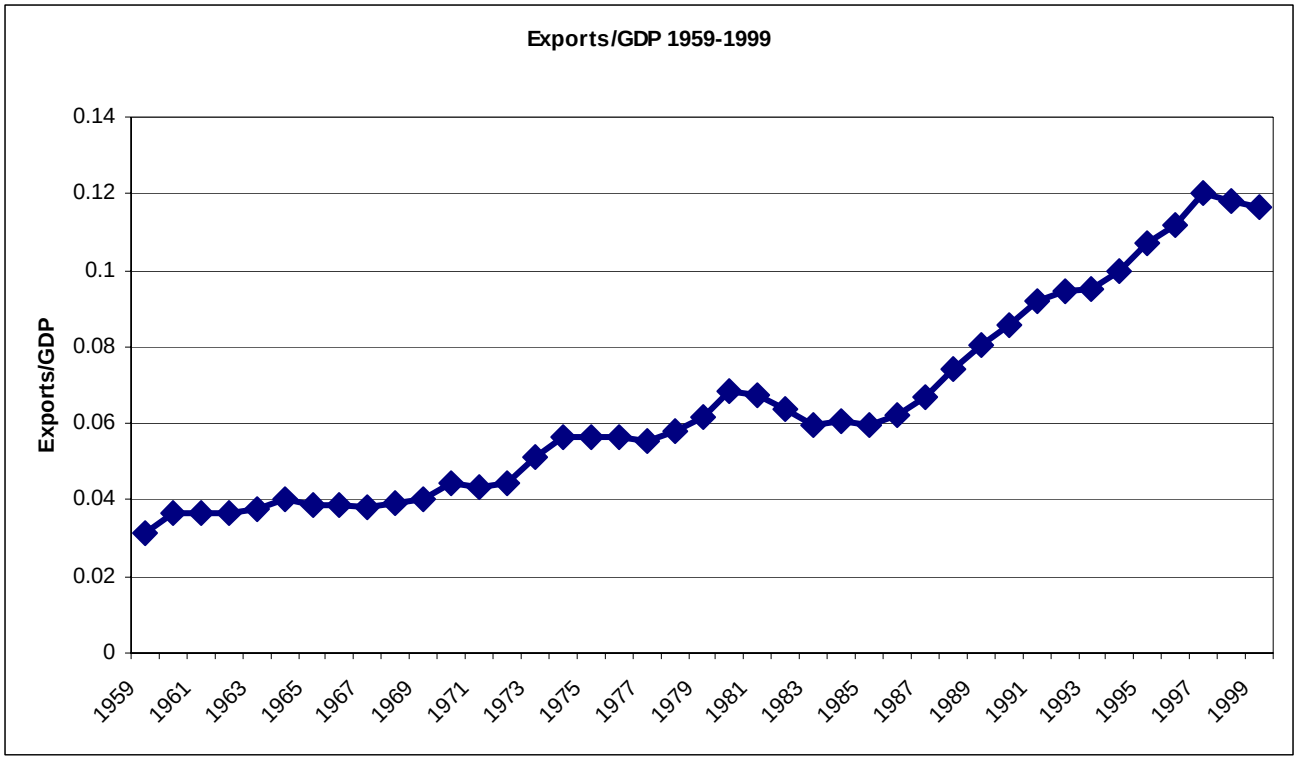
Source: Economic Report of The President, 1996

Figure 2



Source: Economic Report of The President, 2001

Figure 3



Source: Economic Report of The President, 2001

Figure 4

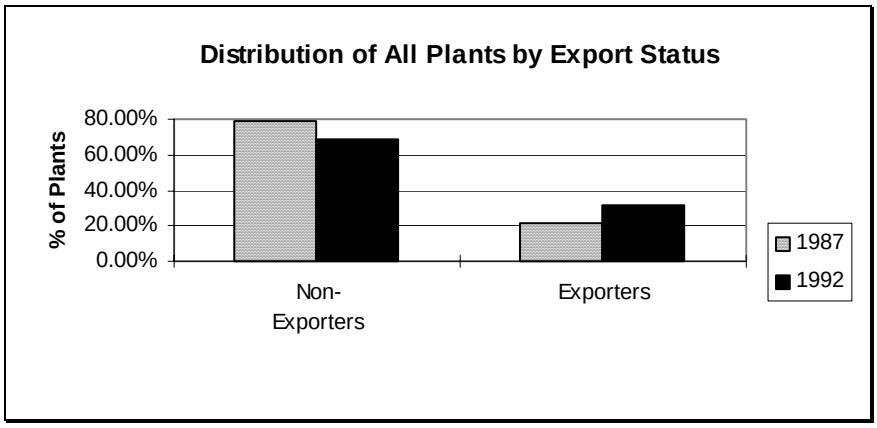

Distribution of All Plants by Export Status
% of Plants
80.00%
60.00%
40.00%
20.00%
0.00%
Non-Exporters
Exporters
1987
1992

Figure 5

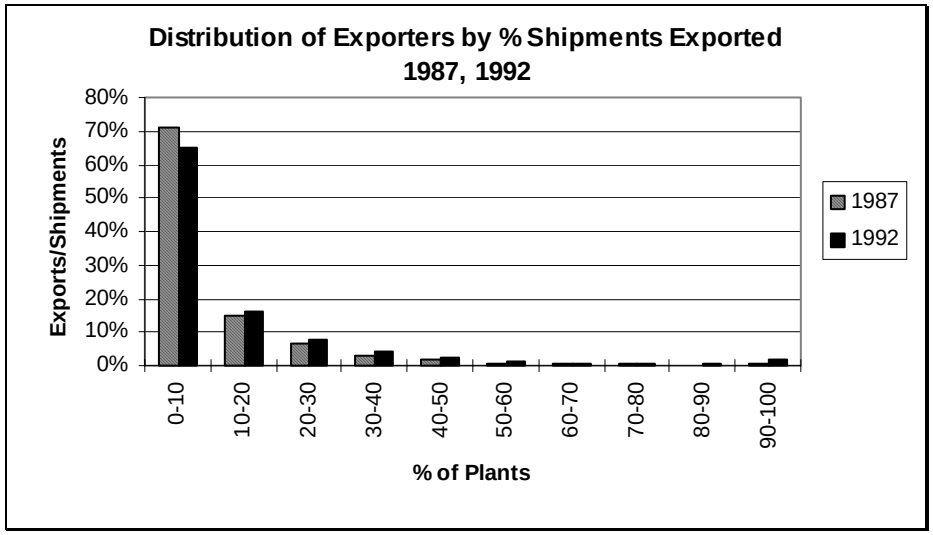

Distribution of Exporters by % Shipments Exported
1987, 1992
Exports/Shipments
80%
70%
60%
50%
40%
30%
20%
10%
0%
0-10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
% of Plants
1987
1992

Table 1: The Export Boom Across Industries

	Average Annual Growth, 1987-92		Exporters /Total Plants	
	Shipments	**Exports**	**1987**	**1992**
Food	5%	23%	15%	23%
Tobacco	14%	28%	45%	51%
Textiles	3%	27%	16%	25%
Apparel	2%	34%	5%	9%
Wood	2%	14%	12%	18%
Furniture	3%	65%	10%	25%
Paper	4%	13%	19%	31%
Printing	4%	43%	5%	10%
Chemicals	7%	11%	40%	49%
Petroleum	3%	17%	22%	30%
Rubber	6%	21%	26%	36%
Leather	0%	11%	19%	28%
Stone	0%	14%	14%	21%
Primary Metals	3%	26%	27%	39%
Fabricated Metals	2%	16%	21%	31%
Machinery	3%	17%	33%	43%
Electronics	5%	16%	37%	46%
Transportation	3%	11%	29%	40%
Instruments	5%	12%	48%	55%
Miscellaneous	4%	25%	20%	34%
Total	4%	15%	21%	30%

Table 2: The Export Boom Across States

	Average Annual Growth 1987-92	
	Shipments	**Exports**
Maine	1%	13%
New Hampshire	-2%	9%
Vermont	7%	6%
Massachusetts	0%	11%
Rhode Island	-5%	3%
Connecticut	1%	9%
New York	0%	11%
New Jersey	1%	15%
Pennsylvania	3%	17%
Ohio	3%	10%
Indiana	5%	16%
Illinois	4%	13%
Michigan	2%	4%
Wisconsin	5%	25%
Minnesota	4%	2%
Iowa	6%	14%
Missouri	5%	2%
North Dakota	9%	24%
South Dakota	12%	2%
Nebraska	9%	41%
Kansas	4%	19%
Delaware	4%	29%
Maryland	2%	10%
Virginia	5%	18%
West Virginia	3%	1%
North Carolina	6%	28%
South Carolina	5%	22%
Georgia	4%	26%
Florida	1%	12%
Kentucky	7%	17%
Tennessee	6%	20%
Alabama	6%	28%
Mississippi	6%	16%
Arkansas	7%	36%
Louisiana	5%	11%
Oklahoma	5%	19%
Texas	6%	10%
Montana	4%	6%
Idaho	9%	60%
Wyoming	6%	6%
Colorado	5%	23%
New Mexico	26%	27%
Arizona	5%	17%
Utah	11%	31%
Nevada	5%	17%
Washington	11%	32%
Oregon	5%	23%
California	4%	14%

Table 3 : Exports by Plant Type

Plant type	**Exports - 1987**		**Exports - 1992**		**Change in Exports**	
	($millions)	% of total	($millions)	% of total	($millions)	% of total
New	$0	0%	$23,392	11%	$23,392	29%
Failed	$13,241	11%	$0	0%	($13,241)	-16%
Continuing	$111,941	89%	$182,693	89%	$70,751	87%
Stoppers	*$9,723*	*8%*	*$0*	*0%*	*($9,723)*	*-12%*
Starters	*$0*	*0%*	*$30,801*	*15%*	*$30,801*	*38%*
Both	*$102,218*	*82%*	*$151,891*	*74%*	*$49,673*	*61%*
All	$125,183		$206,085		$80,901	

Table 4 : Decomposition of Export Growth (1987-1992)

Exporter Type	Growth Effect: Change in Shipments * Average Export Intensity ($millions)		Intensity Effect: Change in Export Intensity * Average Shipments ($millions)		Total ($millions)	
Stoppers	139	0%	-9,861	-14%	-9,722	-14%
Starters	4,149	6%	26,652	38%	30,801	44%
Both	21,547	30%	28,125	40%	49,673	70%
All Continuing	25,836	37%	44,916	63%	70,752	100%

Table 5 : Changes in Exports, Exports/Shipments 1987-1992

(All Plants)

	Dependent Variable			
	Change in Exports (DHS measure)		**Change in Export Intensity** (Exports/Shipments)	
	Estimate	t-statistic	Estimate	t-statistic
Exchange Rate	-0.924	31.52	-0.043	14.82
Foreign Income	0.752	15.38	0.072	14.65
Labor productivity	0.033	8.52	-0.001	1.31
N	106510		106510	
R^2	0.044		0.018	

Table 6 : Changes in Exports, Exports/Shipments 1992-1987

Continuing Exporters

	Dependent Variable					
	Change in Exports (ΔlnExports)		**Change in Exports** (DHS measure)		**Change in Export Intensity** (Exports/Shipments)	
	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
Exchange Rate	-2.558	16.56	-1.809	18.61	-0.152	11.51
Foreign Income	1.321	5.39	0.981	6.36	0.135	6.43
Labor productivity	0.186	9.40	0.135	10.81	-0.009	5.42
N	14434		14434		14434	
R^2	0.100		0.125		0.062	

Table 7 : Changes in Exports - Decomposition

All Plants, 1992-1987

	Dependent Variable			
	Growth Effect		**Intensity Effect**	
	Estimate	t-statistic	Estimate	t-statistic
Exchange Rate	286.2	0.49	-1109.5	3.38
Foreign Income	3414.8	3.48	2773.4	5.07
Labor productivity	676.5	8.62	130.7	2.99
N	106497		106497	
R^2	0.001		0.002	

Table 8 : Contributions of Foreign Income, Exchange Rates and Productivity to Export Growth

	Size Groups							
Actual	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	ΣQuintiles	Δ in Total Exports	
Growth Effect	0.7%	1.2%	2.9%	10.1%	85.1%	25,836	70,752	36.5%
Intensity Effect	0.6%	1.2%	3.5%	10.8%	83.9%	44,916		63.5%
Estimated								
Growth Effect								
Exchange Rate	-0.9%	-1.4%	-2.0%	-0.6%	104.8%	(8,492)	60,818	-14.0%
Foreign Income	0.3%	0.5%	1.4%	6.4%	91.4%	27,265		44.8%
Productivity	-0.2%	0.1%	1.1%	9.1%	89.8%	5,317		8.7%
Intensity Effect								
Exchange Rate	0.0%	1.7%	4.3%	12.8%	81.2%	11,196		18.4%
Foreign Income	1.1%	1.2%	3.0%	9.1%	85.6%	24,746		40.7%
Productivity	0.3%	0.3%	2.5%	28.2%	68.7%	783		1.3%